

embryo stage; and the form of that incipient canal-system is remarkably like the chamber left in the semiseptate dome at the base of *Haliphysema*. I may add, when referring to Barrois, that at pl. xiii. fig. 15 he gives a capital illustration of pseudopodial action in the young of *Grantia compressa*—an additional witness to what I have stated in the earlier part of this paper, that the protrusion of pseudopodial processes in *Haliphysema* is no proof whatever that it is not a sponge.

EXPLANATION OF PLATE XVI.

Fig. 1. *Haliphysema confertum*, Norman, $\times 40$.

Fig. 2. *Haliphysema confertum*, Norman, a single individual separated from the group, $\times 150$.

Fig. 3. *Technitella legumen*, Norman, $\times 40$.

Fig. 4. *Technitella legumen*, Norman, anterior portion, $\times 40$.

Fig. 5. *Technitella melo*, Norman, $\times 100$.

Fig. 6. *Technitella melo*, Norman, posterior portion, $\times 40$.

Fig. 7. *Marsipella elongata*, Norman, $\times 100$.

XXXI.—*On the Architectural Achievements of little Masons, Annelidan (?) and Rhizopodan, in the Abyss of the Atlantic.* By the Rev. A. M. NORMAN, M.A.

No group of Invertebrata has received more important additions through the recent dredgings in the North Atlantic than the Arenaceous Foraminifera. The mode of incorporation of extraneous material in the tests of these and of other Rhizopoda, and also in the tubes of what are presumed to be cases of minute Annelids, is not only marvellously beautiful, but appears also to be almost endlessly diversified. The power of selection evidenced is truly wonderful: from the same ground, and therefore from the midst of the same material for use, I have seen as many as seventeen different species, each of which has a specific individuality of its own in the choice and mode of appropriation of the particles, whether of mineral or organic origin, which it selects from the mud—and this wholly apart from characters which depend on the form of the one or more chambers which constitute the animal or tube. To exemplify my meaning I will throw the classes of diversity into tabular form, so as to give some slight idea of the varied ways in which these clever little artificers set about their work and construct their dwellings.

A. Material chosen by the Artificers.

1. Coarse sand-grains, almost entirely of quartz.
2. Medium-sized quartz-grains.

3. Comminuted dust of quartz.

The above workers, though living together and, so to speak, getting their material from the same quarry, are most particular as to the size of the stones they respectively build with.

4. Various grains of different colours, many black (apparently manganese), giving the whole test a grey colour*.
5. Sponge-spicules, rarely of any other form than acerates; but while one (A) will select only fragments of large acerates, another (B) will reject every thing save the smallest spicules.
6. *Globigerina*-shells used exclusively.
7. Test made of sand-grains of small size, with here and there a *Globigerina* stuck in a conspicuous manner on the outside, as though for ornament.
8. Tests formed of the minutest particles of "*Globigerina*-ooze," consisting of coccoliths &c.
9. Tests in which flat fragments of the shells of bivalve Mollusca form conspicuous objects; the fragments may be so built together as to form (A) a produced series of chambers (after the form of *Valvulina gramen*, D'Orb.), or (B) a flattened disk, as, for example, *Astrorhiza limicola*, Sandahl.

So much for the material employed; but there are also various ways of working up the objects into the structures. Here are some:—

B. Modes of using the Building-material.

1. A promiscuous mixture of little pebbles of various kinds, of larger *Globigerinae* and other Foraminifera. This is, perhaps, the least-interesting builder (see "coarse type of Nodosarine *Lituola*," Carpenter, *Microscope*, p. 531, fig. 271, e).
2. The selected quartz-grains (whether 1, 2, or 3 of last list) may be used in various ways—either roughly cemented together, with their angles projecting, as in a "rough-cast" wall: of this mode of building, *Botellina*, *Rhabdammina abyssorum*, Sars, *Storthisphaera albida*, Schultze, and some microscopic (annelid?) tubes are examples. Or,
3. They may build with most wonderful exactness, each grain fitted carefully into the interstices of its neighbours, so that there is hardly any space left to be filled up by the

* This is the species which has just been recorded by Mr. H. B. Brady under the name *Spiroloculina celata*, Costa, in a paper "On the Occurrence of Chalk in the New-Britain Group," *Geol. Mag.* dec. ii. vol. iv. no. 12, Dec. 1877, p. 7 (separate copy).

- cement-mortar, the mode of building reminding us of the careful dovetailing and fitting of the stones in a Cyclopean wall : of this mode of building, a *Diffugia* (?) from Davis Strait affords a type. Or,
4. The material may be so built as to present a tolerably even smooth surface, although the faces of the grains are still exposed, as in the "Globigerine," "Nodosarine," and "Orbuline *Lituola*," figured by Carpenter 'Microscope,' p. 533, fig. 273, *a, b, c, g, h.* Or,
 5. The sand-grains may be entirely plastered over and covered by the sarcode-cement, so that the surface is smooth and polished, like the face of a wall built of rubble imbedded in cement : of this, *Cyclammina cancellata*, H. B. Brady, MS., and some other beautiful undescribed forms are examples.
 6. So with the employment of sponge-spicules. Nothing but fragments of large spicules may be employed : and these may be (A) laid longitudinally and cemented into a rough tube, or (B) they may be used only in one particular part of the structure, as in *Marsipella elongata*, Norman. Or,
 7. Nothing but the smallest spicules may be used, and these incorporated with great exactitude in the walls, none of them projecting to the smallest degree, as in *Technitella legumen*, Norman, and an undescribed tube. Or,
 8. They may be projected at right angles to the surface, standing out hedgehog-fashion from the wall, as in *Pilulina Jeffreysii*, Carpenter, and in some beautiful tubes in my collection. Or,
 9. A spicule may stand out here and there from a wall which is mainly built up of very finely comminuted material, as in Carpenter's "moniliform *Lituola*" (*l. c.* fig. 271, *f*) and in another species in my collection. Or,
 10. A single large spicule may be employed to form an axis, on the middle of which a little sand ball is wrapped, so that it has the appearance of being spitted by the spicule, which projects many times the length of the ball on each side of it.
 11. The Globigerine shells, to the exclusion of every thing else, are built up into a form closely related to *Lituola scorpiurus* (Montfort).

C. Colour of Deep-sea Arenaceous Foraminifera.

1. White: *Technitella legumen*, Norman, *T. melo*, Norman, or the *Globigerina*-building form just referred to.

2. Dirty brown (sand-colour, as we ordinarily term it): *Astrorhiza arenaria*, Norman, or "Orthocerine *Lituola*" of Carpenter.
3. Rust-coloured or ferruginous, the tint (a) dark: *Cyclamina cancellata*, Brady, MS. (b) rich and ruddy: *Trochammina irregularis*, the tadpole-shaped form figured, Carpenter, Introd. Foram. pl. xi. fig. 6; *Trochammina gordialis*, P. & J.; and *Astrorhiza catenata*, Norman. (c) pale: *Lituola canariensis*, D'Orb., and the forms mentioned under B.
4. Grey: see A, 4.
5. Very dark, almost black, as in an abyssal Foraminifer which seems to be identical with the fossil *Nodosaria Schlichtii*, Reuss.
6. Green: the green sarcode in *living* specimens is often very vivid. I have an undescribed scale-like form which has been dead eleven years; yet on being wetted the green colouring is most conspicuous.

The above brief notes will give some notion of the wonderful skill displayed by these little architects. I have made no allusion to the very great variety of form in their dwellings; and inasmuch as the greater number of the species from which these Notes are drawn remain still undescribed, I have only been able to illustrate my meaning by reference to a few named species. Brief as the Notes are, I have thought that they would have interest at the present moment as connected with structures built by *Haliphysema*, *Technitella*, and *Marsipella*.

XXXII.—*Descriptions of new Species of Heterocera from Japan.*—Part II. *Noctuites*. By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

[Continued from p. 204.]

Amphipyridæ.

134. *Amphipyra erebina*, n. sp.

Allied to *A. perflua*, but rather smaller, more sericeous; the primaries with the inner zigzag stripe obscured, the outer stripe less white and not so regularly dentate-sinuate, the external area greyer, with the markings less distinct; a blackish lunate subapical patch: secondaries dark grey instead of pale brown; fringe and marginal edge sordid whitish. Wings below streaked with grey, the discal band darker and more sharply